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Radiological Terrorism – Direct and Indirect Impacts of RDD Events

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Radiological terrorism

1. Violation of safe operation of nuclear facilities, including NPP, NFC facilities and other radiation hazardous objects, resulting in release of radioactivity
2. Direct release of radioactive substances into environment.

Both aimed at:

- direct damaging to the population health and the environmental state;
- indirect damaging to the society caused by radiophobia factor.

Application of Radionuclide Sources

Equipment containing radionuclide sources is widely used in different industries, namely:

- **Nuclear Power and Engineering,**
- **Metallurgy,**
- **Geology,**
- **Mining,**
- **Meteorology,**
- **Chemical and Petroleum Industries,**
- **Medicine and Agriculture.**

Targets for radioactive contamination

- settlements;
- drinking water;
- foodstuff, clothes, etc.;
- agricultural lands;
- apartment houses, production facilities, storehouses;
- transport communications;
- public places.

Mechanisms of Dispersion in the Environment

- blasting (aerosols, gases);
- thermal effect (aerosols, gases);
- dispersion of liquids (aerosols, vapour, steam);
- dilution in aquatic environment;
- installation of IRS in public places.

Direct and Indirect Damages to the Population Health & the Environment and Losses in Social and Economic Activities

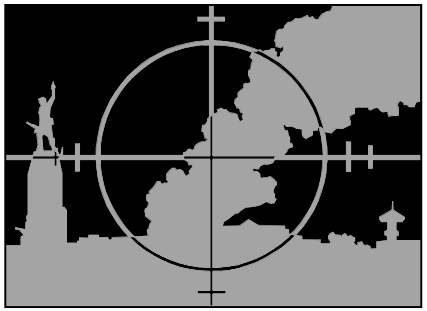
Actual perception of the radiation risk all over the world taken together with perfect & easily accessible devices able to detect any increase in the radiation background (_ and _) result in major indirect damages (psychological stress; economical, social and political losses) as compared to minimum and even negligible radiation effects on both the human health and the environment.

Direct and Indirect Damages to the Population Health & the Environment and Losses in Social and Economic Activities

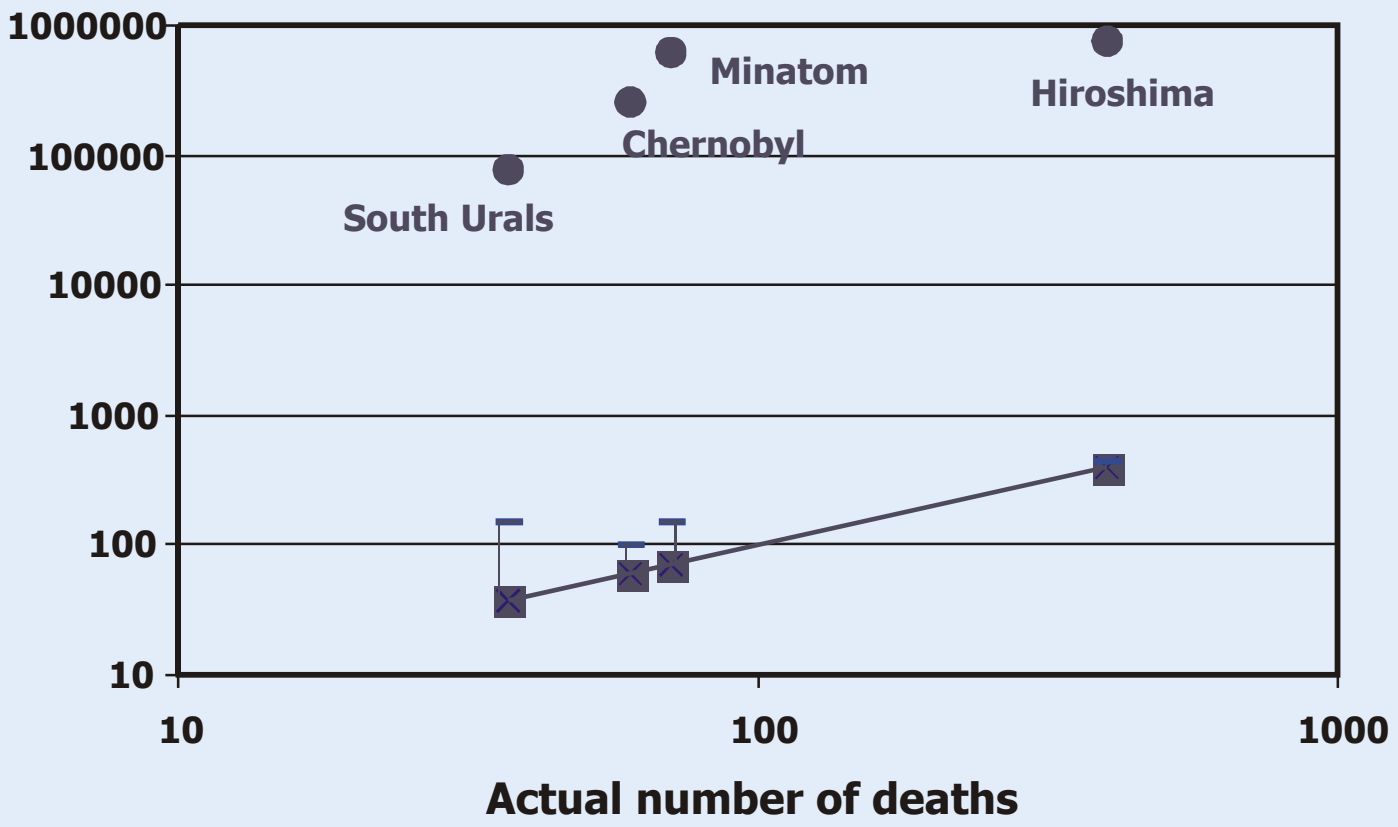
Relative difficulties in detecting low concentrations of some α-types of radiation (Pu, etc.) in combination of extremely acute perception of their hazard effects could also result in severe indirect consequences even in case of imitation of radiological terrorist attacks.

Inadequate perception of radiation risk

What do you know of victims of A-bomb and Chernobyl?

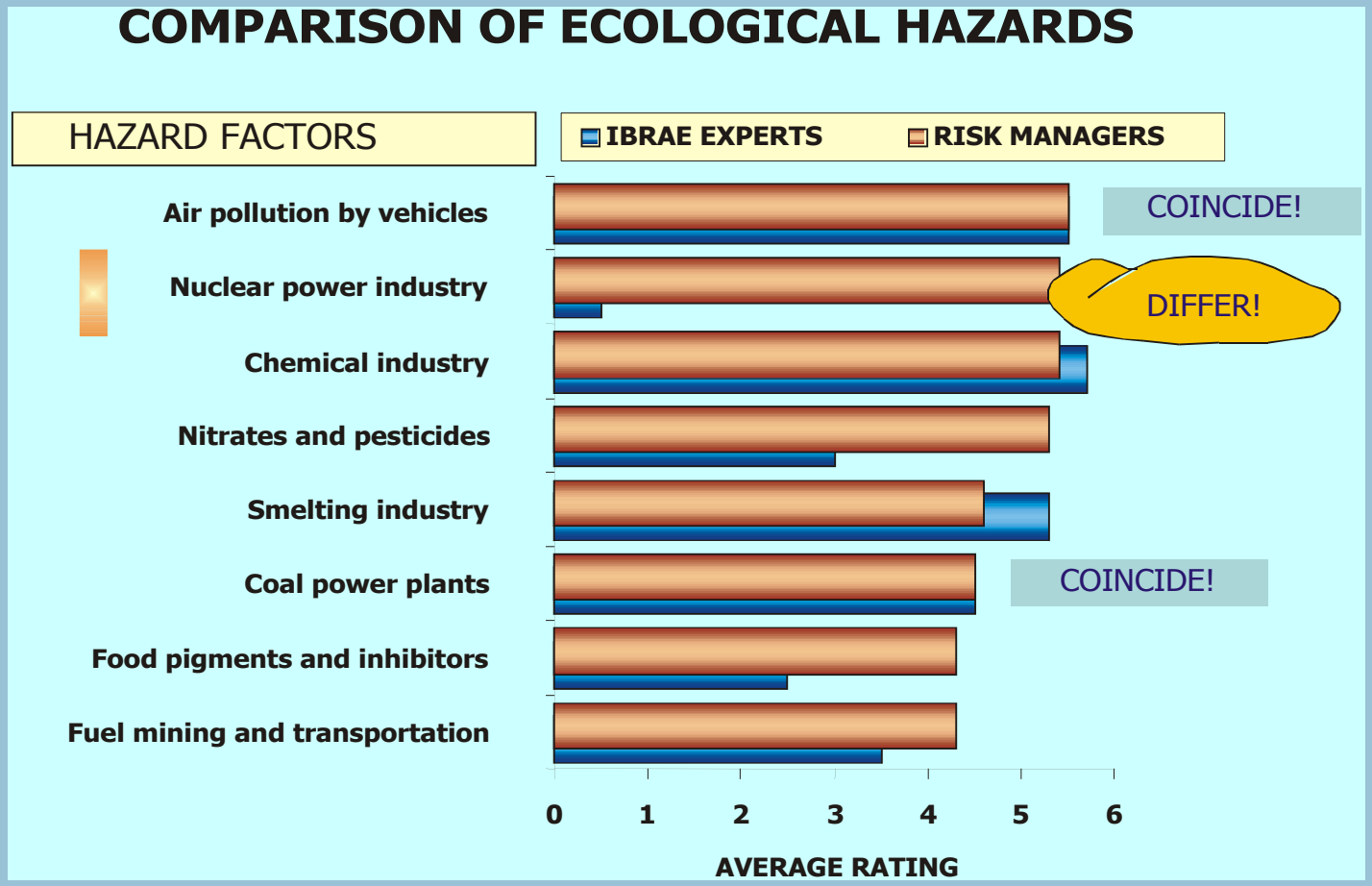
	Actual death-roll, persons	Students' estimates (average)
 **Hiroshima**	**Death in 2 months** **210 000**	**270 000**
	Long-term effects in suvivors (86572 pers.) **421**	**750 000**
 **Chernobyl**	**Death in 3 months** **31**	**40 000**
	Long-term effects in liquidators ≈ 60 – 80 and Children in BO	**253 000**

Analysis of public opinion



Results of the poll with the students of the Lomonosov University in Moscow «What do you know about the distant consequences of radiation accidents?»

Analysis of public opinion



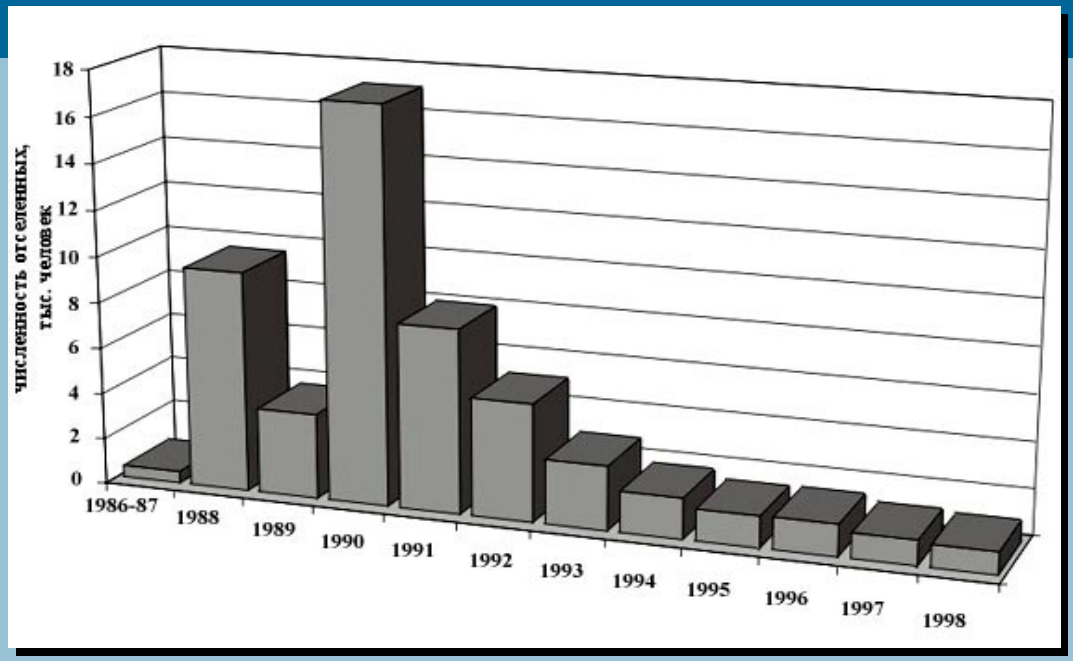
Comparative rating of various hazard factors by risk managers and IBRAE experts. The estimates are in a good agreement for all factors but nuclear power industry.

Minimized vs. Actual Looses from the Chernobyl accident

Population involved USSR/Russia	Management adequate to radiation impact *	Inadequate Management (real facts)
Evacuees	120-130 thousand	
Protected public (interventions)	300 ths. (1-2 year) 100 -200 ths. (< 10 years) < 50 ths. (after 10 years)	7 million people
Emergency workers	30-50 thousand	600 thousand
Other (in Russia)		• 55 thyroid cancer cases in children of the Bryans Region • 50 ths. resettled people

* Based on current intervention levels standards

Inadequate Risk Management in Chernobyl



ICRP recommends resettlement when life-time dose exceeds 1000 mSv

Causeless resettlement after 1989

Averted Dose, mSv		Cost in US Dollars Per 1 man.Sv	
Min.	Max.	Min.	Max.
50	100	130 000	Up to 500 000

Causes of Dramatic Aggravation of the Consequences of the Radiation Impact on the Population:

- Historical and psychological reasons (nuclear arms race, Hiroshima, Nagasaki);
- Distorted knowledge of the radiation risk levels (Hiroshima, Nagasaki, Chernobyl, South Ural, etc.) by virtually all social-professional population groups;
- Unjustified strict radiation safety standards;

Causes of Dramatic Aggravation of the Consequences of the Radiation Impact on the Population:

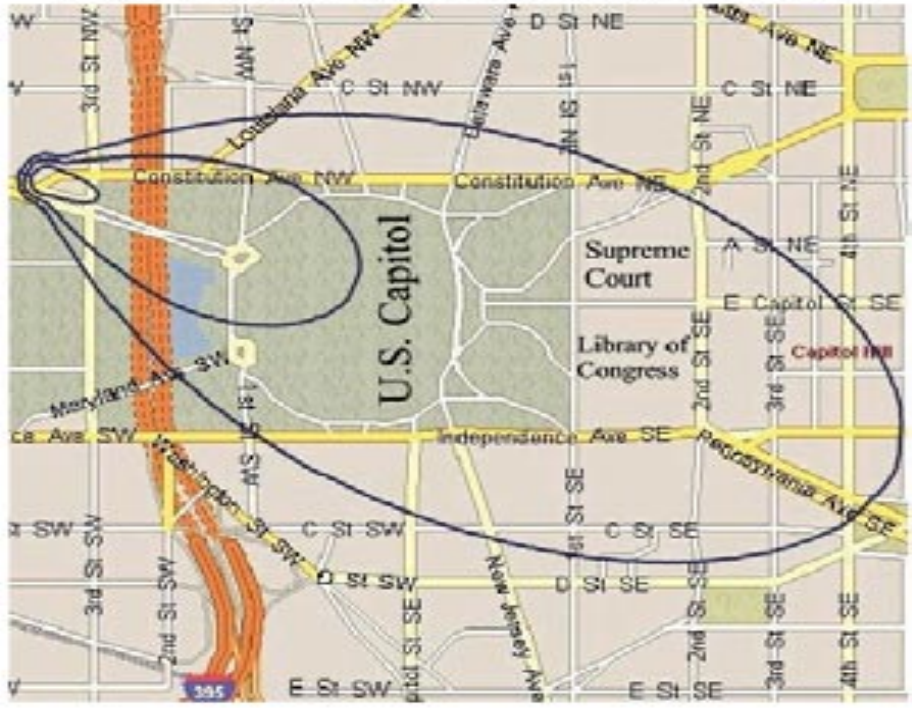
- Acute perception of radiation risks by public consciousness;
- Inadequate efficiency of the information policy in the field of atomic energy use for peaceful purposes (including education);
- Unequal Response on radiation incidents at international, national, regional and local levels.

Information, Analytic and Scientific Foundations to Solve Tasks of Preventing and Minimizing the Consequences of Radiological Terrorist Attacks

The existing information, analytic and scientific support for solving the problems of preventing and minimizing consequences of radiological terrorist acts and their threats is poorly developed.

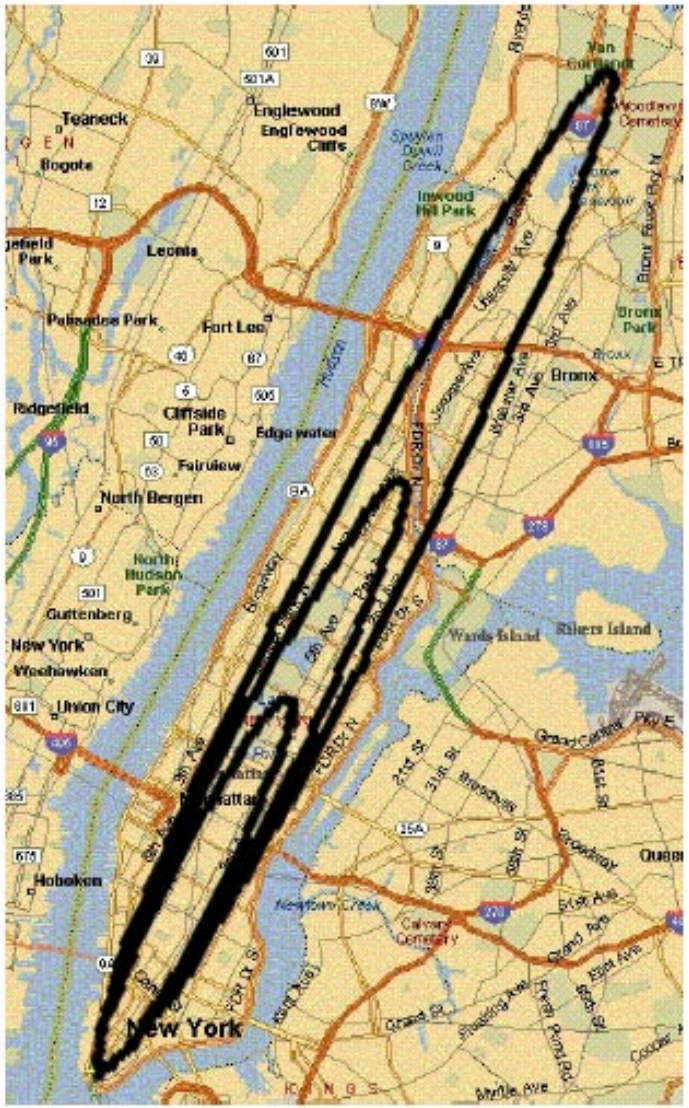
Testimony of Dr. Henry Kelly, President Federation of American Scientists before the Senate Committee on Foreign Relations (March 6, 2002)

Figure 1: Long-term Contamination Due to Cesium Bomb in Washington, DC



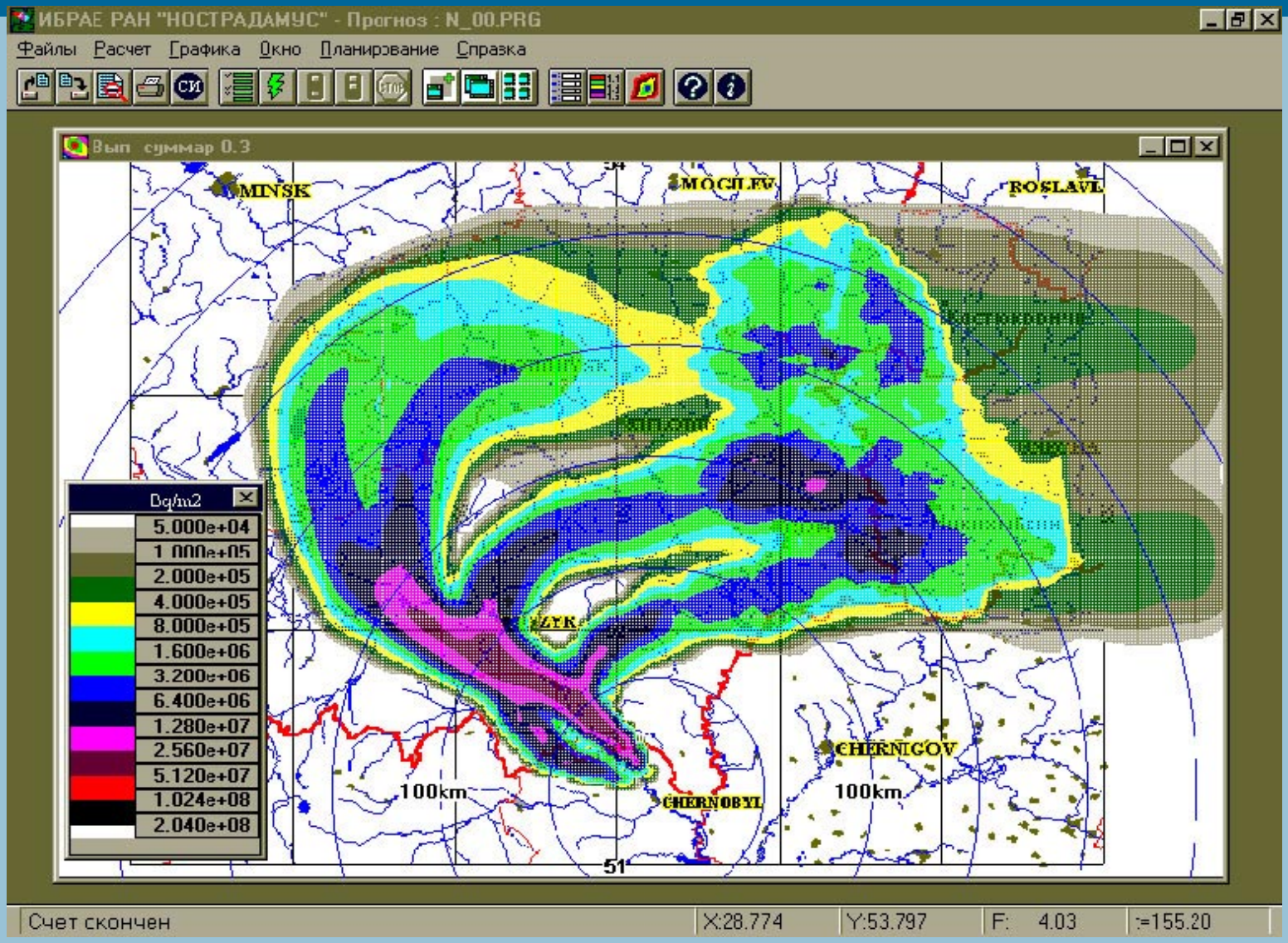
Inner Ring: One cancer death per 100 people due to remaining radiation
Middle Ring: One cancer death per 1,000 people due to remaining radiation
Outer Ring: One cancer death per 10,000 people due to remaining radiation
EPA recommends decontamination or destruction

Figure 3: Contamination Due to Cobalt Bomb in NYC – Chernobyl Comparison

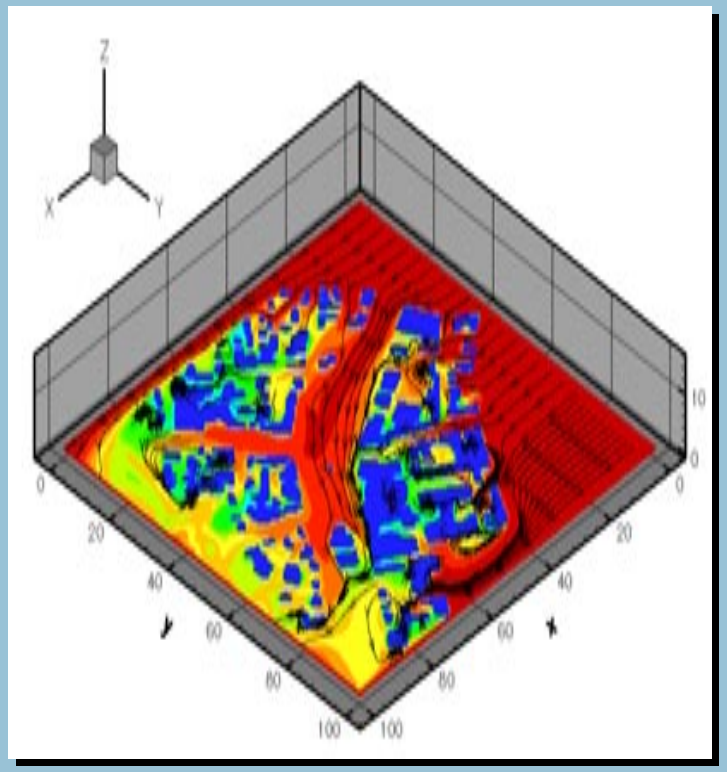


Inner Ring: Same radiation level as *permanently closed* zone around Chernobyl
Middle Ring: Same radiation level as *permanently controlled* zone around Chernobyl
Outer Ring: Same radiation level as *periodically controlled* zone around Chernobyl

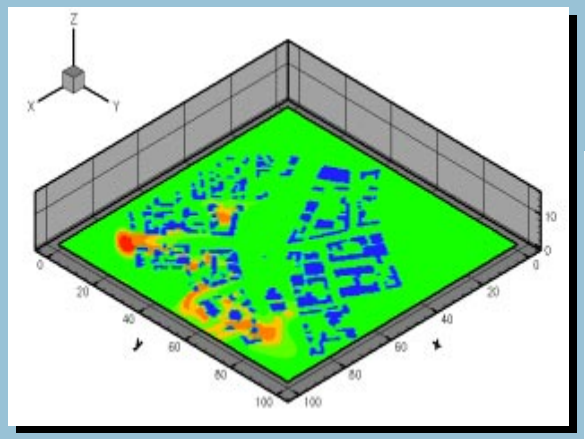
^{131}I contamination density as of April 30 1986 releases of 6:00 a.m. - 3:00 p.m. April 27,1986 (NOSTRADAMUS Code)

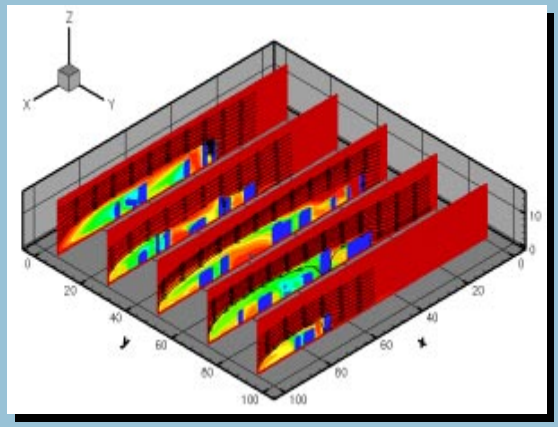


3D Distributed Transport Model of Pollution in Urban Conditions

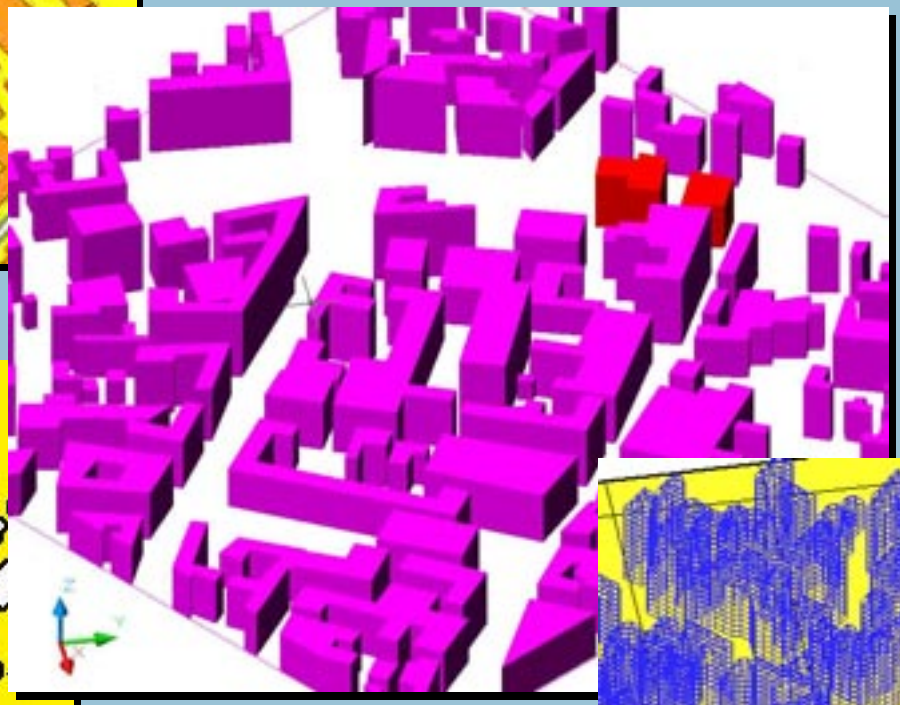


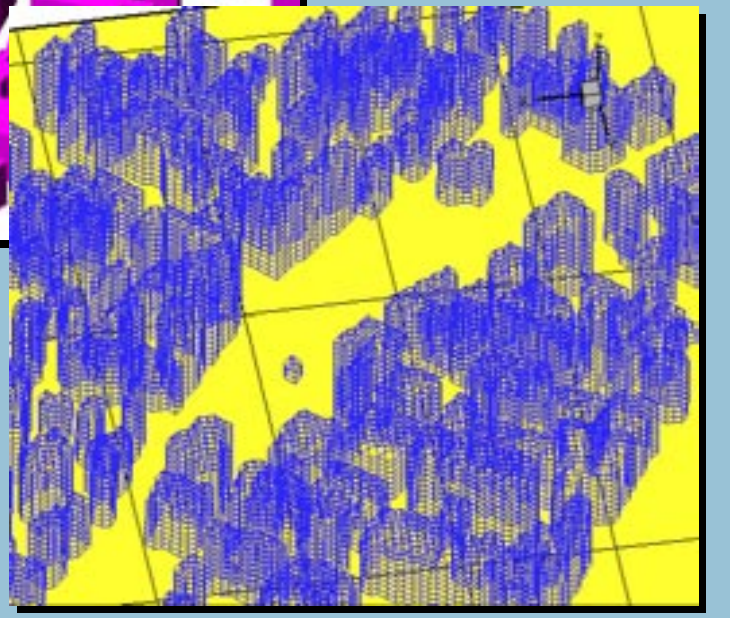
Development of the new 3D Distributed Transport Model of pollution in urban conditions was started at IBRAE in 2001





Conversion 2D map to 3D digital model of the urban area





The basis data for testing calculations:

Radioactive filling of the RDD –

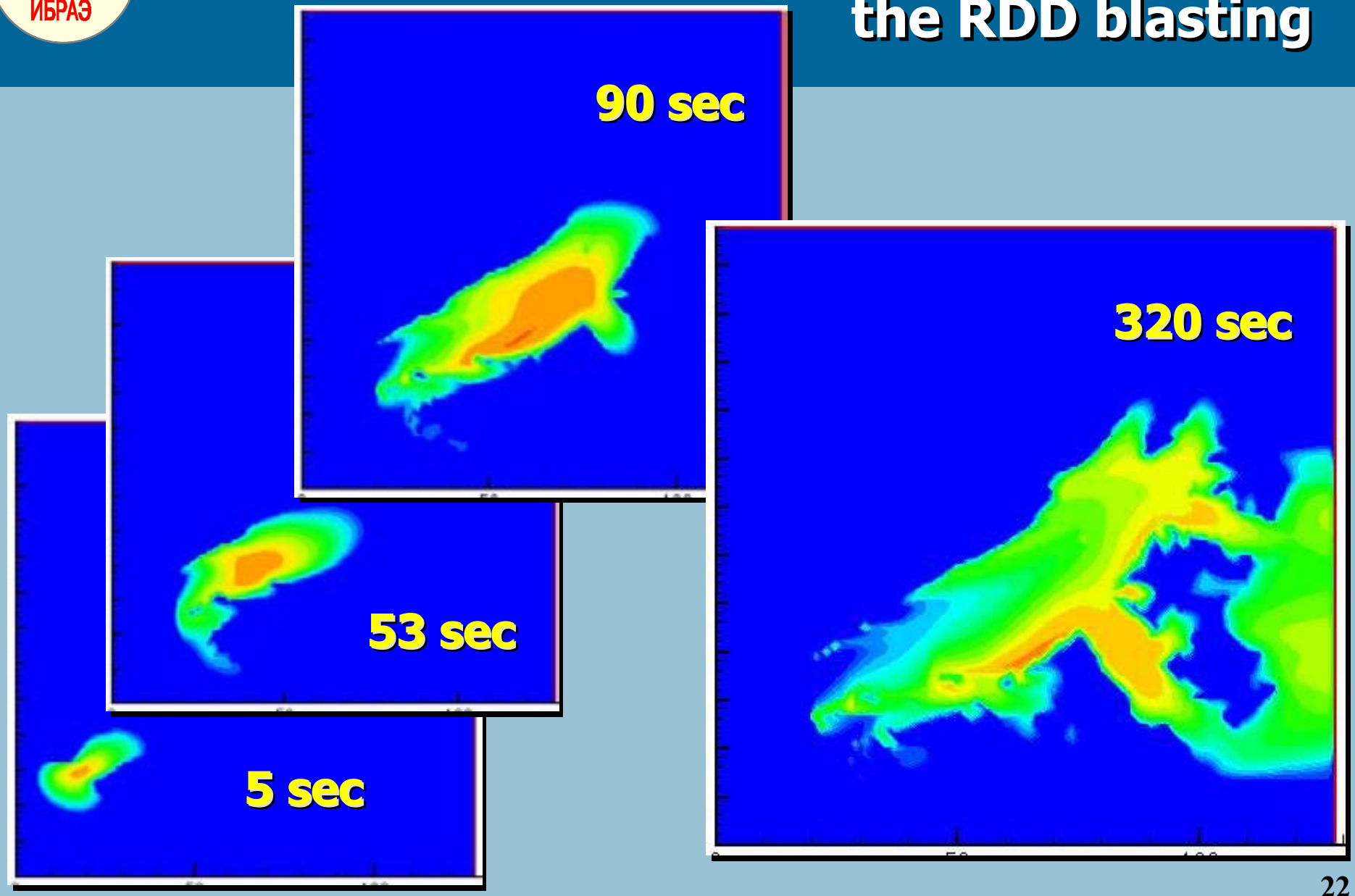
Am-241 source used in oil well surveying;
Activity of source - 1;
Power of blasting - 10 kg TNT;
Initial height of the radioactive cloud - 20 m.

Weather conditions –

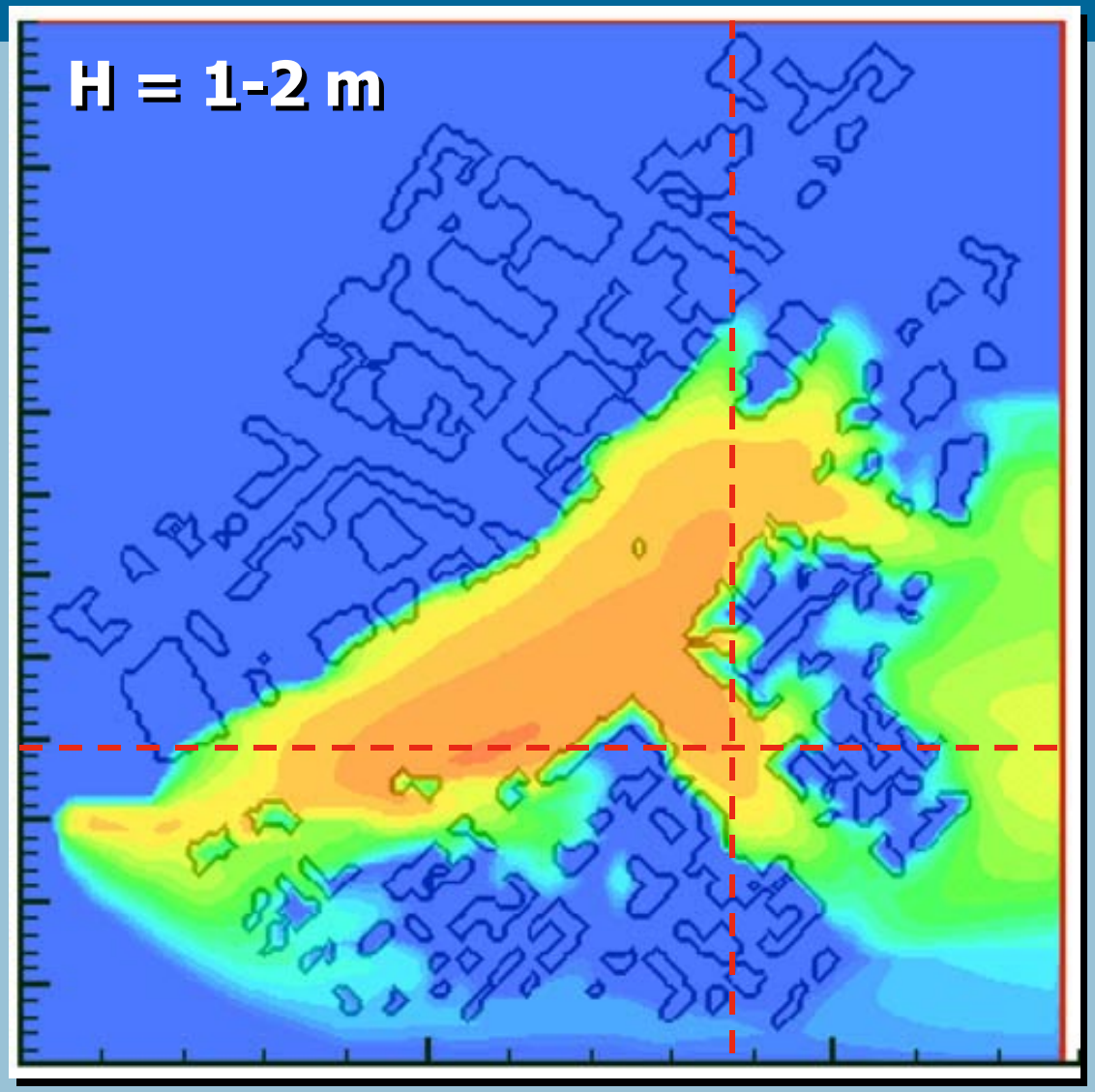
neutral atmospheric stability;
wind speed (10 m) - 5 m/s;
Calculation zone - 1 sq.km;
Population density - 10000 person for 1 sq.km;
In the blasting time - 50% of people are inside and 50% are outside the buildings.

The real population density at the blasting time

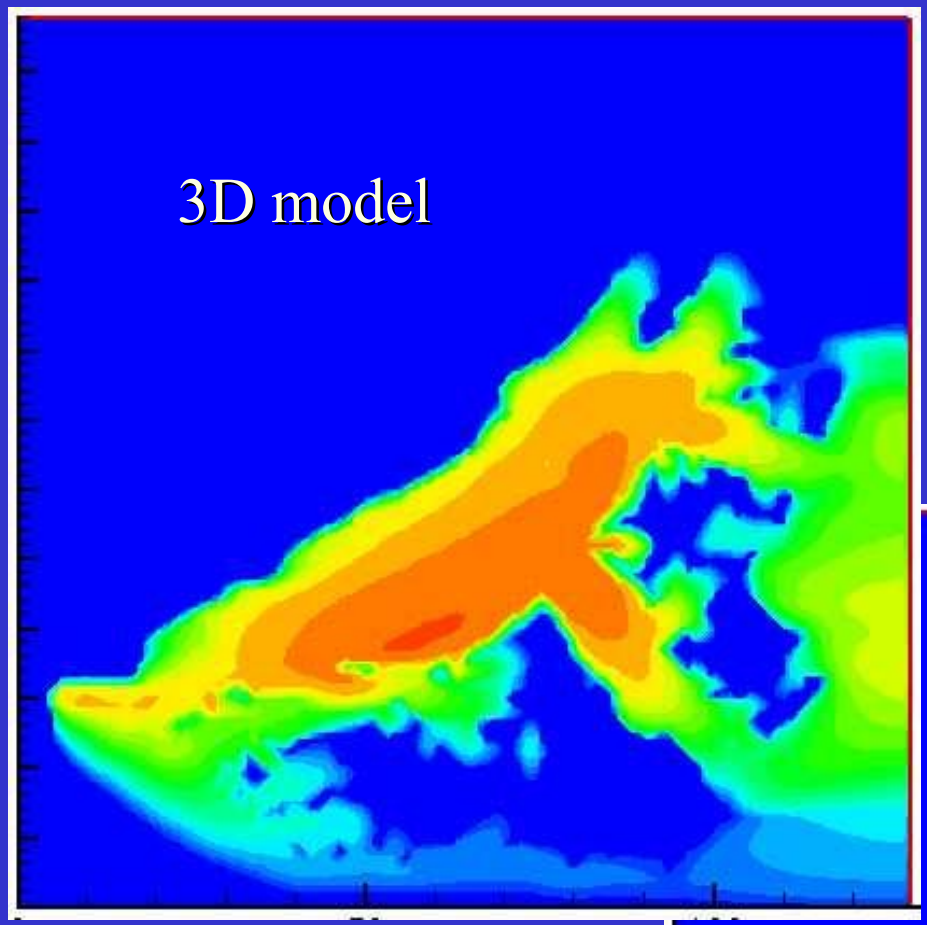
Dynamic of air contamination after the RDD blasting

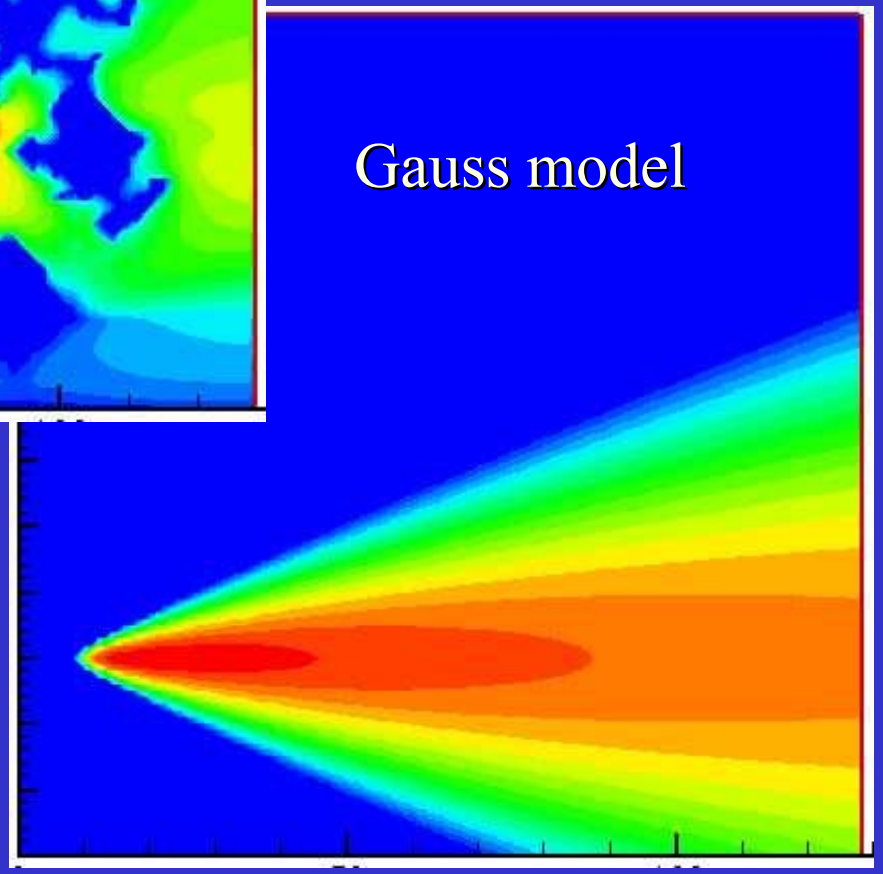


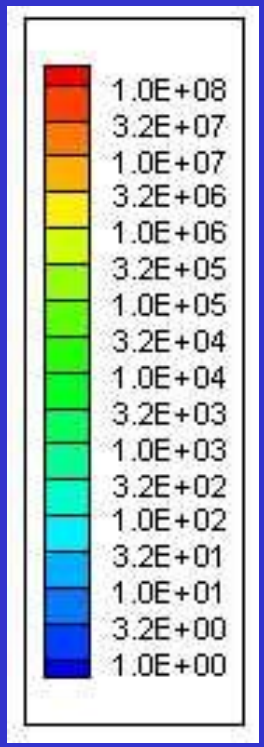
Time-Integrated Air Concentration (TIAC) after the RDD blasting, Bq*sec/cub.m



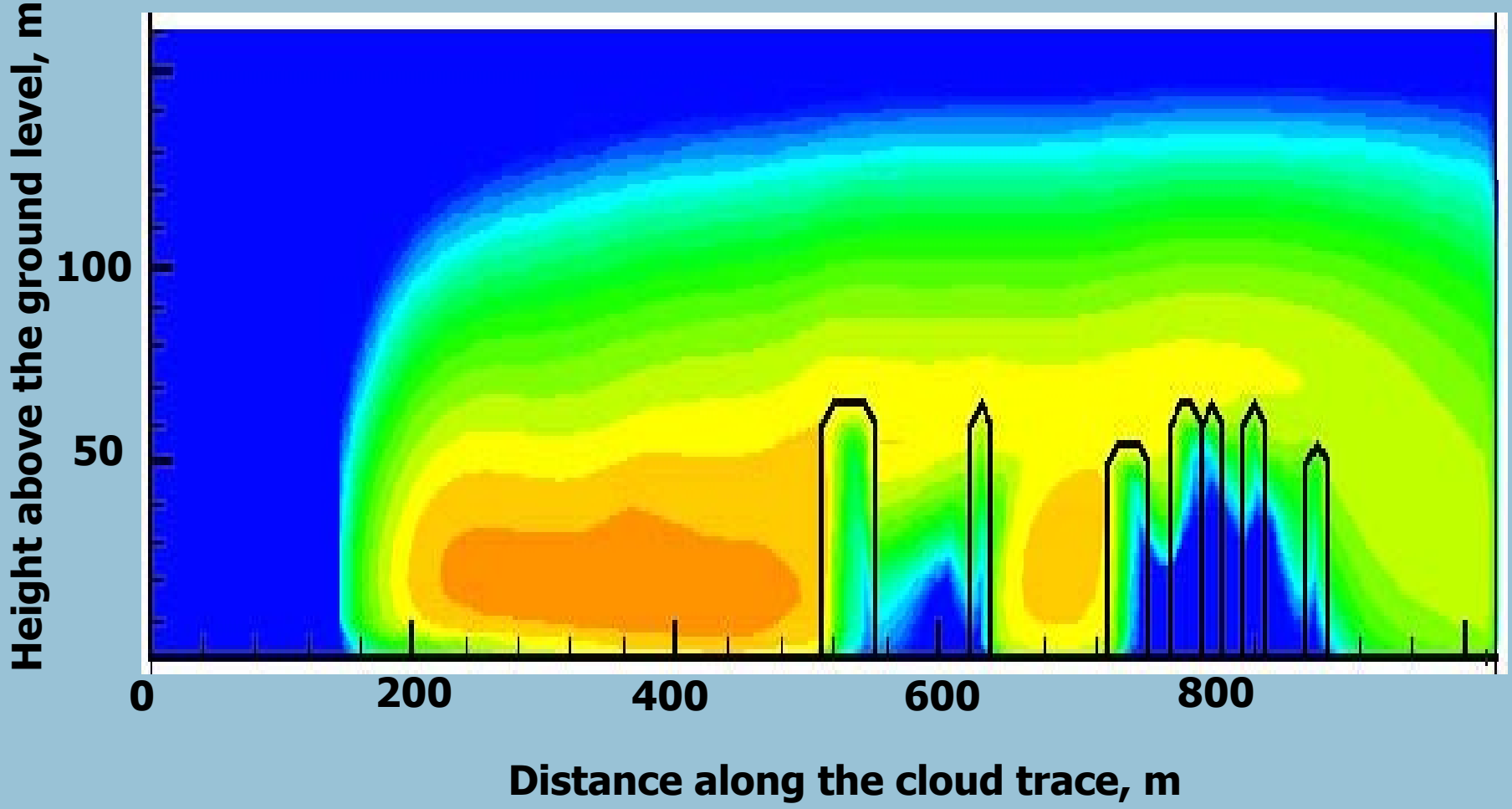
^{241}Am TIAC at H=1-2 m after the "dirty bomb" blasting, relative units



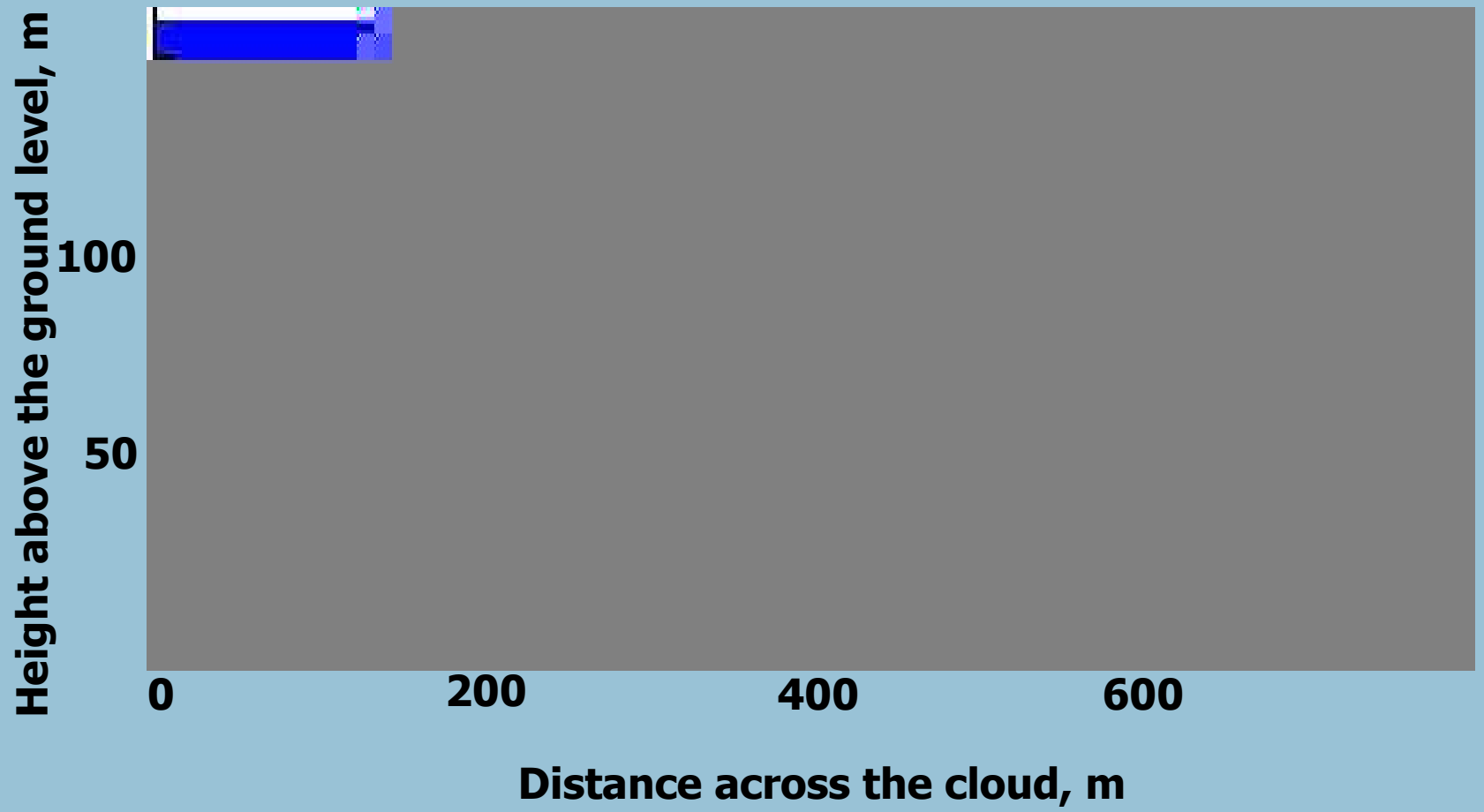




TIAC profile along the radioactive cloud trace (y=300 m) after the RDD blasting, Bq*sec/cub.m



^{241}Am TIAC profile across the radioactive cloud (x=625 m) after the RDD blasting, Bq*sec/cub.m



Distribution of the Absorbed Dose on Lung for population after the ^{241}Am RDD blasting

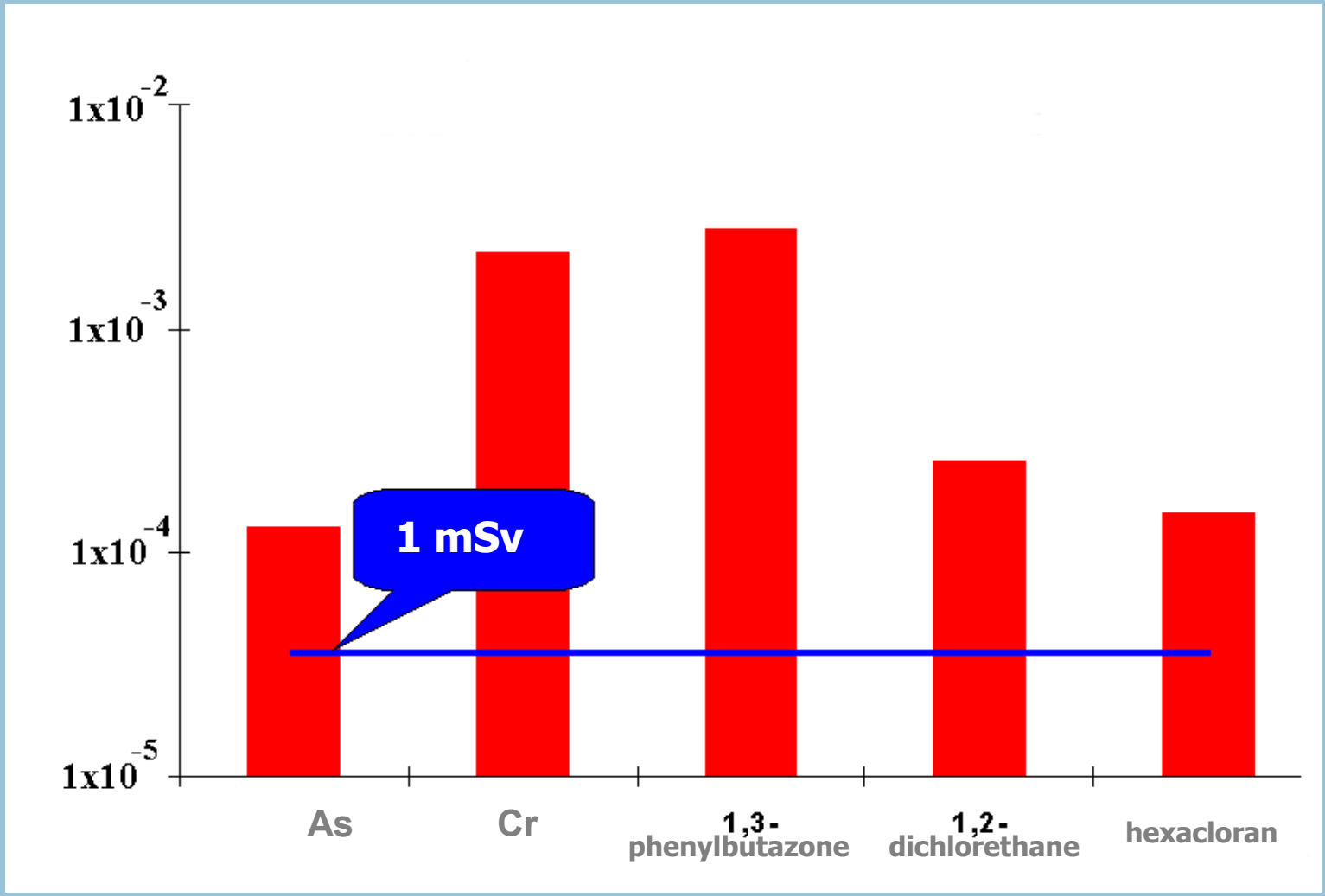
Lung dose, Sv	in the open air	in the building
< 0.05 mSv	622	82
0.05-0.5 mSv	150	23
0.5-5 mSv	171	21
5-50 mSv	283	17
50-500 mSv	249	13
0.5-5 Sv	464	1
5-50 Sv	86	0
> 50 Sv	0	0
total	2023 (1082)	158 (31)

(In brackets - number of the people in zones of protective measures)

Why should we be concerned?

- A great number of IRS used in different areas has significant, high or extremely high level of activity;
- Efficiency of national and international systems of IRS control and accountability, especially in fields other than nuclear industry is not good enough;
- Easy to create RDD, easy to deliver it, easy to disperse;

Carcinogenic risks from chemical and radioactive substances at normative levels



Why should we be concerned?

- **Informational, analytical and scientific data base helping to prevent radiological terrorist acts and to decrease their consequences is not good enough;**
- **Knowledge of first responders, decision makers of radiation risks is not good enough;**
- **Public awareness of radiation risks is really bad.**

What can we do?

- Monitoring of accessibility of ionizing radiation sources (IRS) using a comprehensive analysis of all data on IRS;
- Development of recommendations, programs and realization of primary measures on restoration of an adequate IRS control;
- Development of the concept and programs on improvement of national and international systems for monitoring and accountability of IRS, RW and RM;

What can we do?

Creation of an adequate system of response to radiological terrorism events based upon the existing system of emergency response to nuclear accidents:

- **Development of specific response procedures;**
- **Development of adequate methods and models for assessing consequences and elaborating recommendations on their mitigating;**
- **Development and creation of systems and sensors for radiation monitoring;**
- **Creation of national specialised technical crisis centres;**
- **Organisation of international system of interaction and support.**

What can we do?

Creation of scientific and analytical base for elaboration of justified recommendations and priorities on countermeasures and mitigation of direct and indirect consequences of radiological terrorist acts;

What can we do?

Development and implementation of measures directed to an adequate perception of radiation risks by population in order to decrease the radiophobia level:

- **Information;**
- **Education;**
- **Consolidation of scientific community opinions.**

What can we do?

Perfection of normative and legislative base in radiation safety:

- **for normal every-day life;**
- **in case of radiation accidents and radiological terrorist attacks.**